

Laboratory **Electronics Test and Development Centre, 100 Feet Road, Peenya Industrial Area, Bengaluru, Karnataka**

Accreditation Standard **ISO/IEC 17025: 2005**

Certificate Number **CC-2811 (In lieu of C-0013, C-0022, C-1114)** **Page** **1 of 25**

Validity **02.09.2018 to 01.09.2020** **Last Amended on -**

Sl.	Quantity Measured / Instrument	Range/Frequency	*Calibration Measurement Capability (±)	Remarks
<u>ELECTRO TECHNICAL CALIBRATION</u>				
I.	MEASURE			
1.	DC Voltage ^s	1µV to 100 µV 100 µV to 1 mV 1 mV to 10 mV 10 mV to 100 mV 100 mV to 1000 V 1 kV to 15 kV	1.26 % to 150 ppm 150 ppm to 15 ppm 15 ppm to 5 ppm 5 ppm to 2 ppm 2 ppm 0.46 %	Using DC Ref. Std. Fluke 7000N Ref. Divider Fluke 752, Null Detector AVM 2000, MFC 4808, 5720A, HV Probe HV 80F15, DMM 34401A
2.	AC Voltage ^s	10 Hz to 1 kHz 1mV to 1V 1V to 100V	550 ppm to 30 ppm 30 ppm to 35 ppm	Using TVC Holt 11 AC Voltage meas. Standard Fluke 5790, Keithley Nanovoltmeter 182 HV Probe Tek P6015, 80k40
		40 Hz to 20 kHz 100V to 1000V	30 ppm to 120ppm	
		1 kHz to 100 kHz 1mV to 10mV 10mV to 1V 1V to 100V 100V to 600V	980 ppm to 100 ppm 180 ppm to 25 ppm 25 ppm to 35 ppm 35 ppm to 140 ppm	

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		100 kHz to 1 MHz 1mV to10 mV 10 mV to 100 mV 100 mV to 20 V	150 ppm to 0.34 % 150 ppm to 650 ppm 580 ppm to 57 ppm	
		50 Hz 1 kV to 25 Kv	1.3% to 3.3%	
3.	DC Current ^s	1 nA to 100 nA 100 nA to 1µA 1 µA to 100 µA 100 u A to 1 A 1 A to 10 A 10 A to 100 A	150 ppm to 50 ppm 50 ppm to 10 ppm 10 ppm to 9 ppm 9 ppm to 10 ppm 10 ppm to 25 ppm 25 ppm to 80 ppm	Using Std. Resistor Tinsley 5686,3111,1682 Fluke 742, DMM Fluke 8508A, DMM HP 34401A
4.	AC Current ^s	10 Hz to 1 kHz 10 µA to 1 mA 1 mA to 10 mA	250 ppm to 40 ppm 40 ppm to 95 ppm	Using AC Current shunt Holt HCS - 1 Std. Res. 5685B, 5686, AC Meas . Std Fluke 5790
		10 Hz to 10 kHz 10 mA to 1 A 1 A to10 A	50 ppm to 90 ppm 90 ppm to 130 ppm	
		10 Hz to 5 kHz 10 A to 20A	100 ppm to 200 ppm	
		50 Hz 20 A to 50 A	125 ppm	Using Fluke 520A MFC Dat 4808 Fluke 5220A, Fluke 5720A Keithley 182, Rotek MSB001A

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Sl.	Quantity Measured / Instrument	Range/Frequency	*Calibration Measurement Capability (±)	Remarks
5.	DC Resistance ^s	1 μΩ to 10 μΩ 10 μΩ to 100 mΩ 100 mΩ to 1 Ω 1 Ω to 100 Ω 100 Ω to 1M Ω 1M Ω to 100M Ω 100 M Ω to 1G Ω 1 GΩ to 1 TΩ 1 TΩ to 100 TΩ	100 ppm to 30 ppm 30 ppm to 12 ppm 12 ppm to 2 ppm 2 ppm 2 ppm to 3 ppm 3 ppm to 7 ppm 7 ppm to 240 ppm 240 ppm to 0.11 % 0.11 % to 0.35 %	Using DCC Bridge Guideline 6622A, Std Resistor Tinsley 5686A, L & N, Fluke 742 Series, Ohmmeter 6520
6.	AC Resistance ^s	100 Hz to 1 kHz 0.01Ω to 0.10 Ω 1 kHz 1 Ω to 10 kΩ	460 ppm to 520 ppm 65 ppm to 60 ppm	Using Std. Res. Tinsley 5685/5686A& B, RLC Digi Bridge Quad 1693, Datron/4808 Fluke 5790A
7.	Indutance ^s	1 kHz 10 μH to 100 μH 100 μH to 100 mH 100 mH to 10 H	1.25 % to 0.053 % 0.053 % to 0.015% 0.015 % to 0.032 %	Using Std. self inductor HP 16483A, Tin 4190, Std. Inductor GR 1482, RLC Bridge Quad 1693
8.	Capacitance ^s	1kHz 1pF to 10 pF 10 pF to 100 pF 100 pF to 1μF 1μF to 1F 100Hz 1 μF to 1F	16 ppm to 5 ppm 5 ppm 5 ppm to 150 ppm 150 ppm to 750 ppm 200 ppm to 0.080 %	Using Fused Silica Capacitor A & H 1100, Std. Capacitor GR/1417, HP16380A, Cap.Meas.System GR 1621 RLC Bridge Quad 1693

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Sl.	Quantity Measured / Instrument	Range/Frequency	*Calibration Measurement Capability (\pm)	Remarks
9.	AC Power Active ^s 1 phase 0.2 PF-UPF	50 Hz 60 V to 240V 10 mA to 50A (0.6 W to 12 kW) 1 phase 0.2 PF to UPF	120 ppm to 576 ppm	Using Watt converter Rotek MSB 001A
10.	AC Power Active ^s 3 Ph UPF 0.8 PF 0.5 PF 0.2PF	50 Hz 60 V to 240 V 100 mA to 50 A (3.6 W to 36 kW) 0.2 PF to UPF	0.11 % to 0.27 %	Power Analyzer PM 6000
11.	DC Power ^s	DC 100 mA to 20 A 100 mV to 1000 V (10 mW to 20 kW)	0.005 % to 0.012 %	Using Fluke/8508A (2 DMMs)
12.	Power Factor ^s	50 Hz 0.2 PF to 1PF	135 ppm	Using MSB001, DMM HP 3458A
13.	Phase Angle ^s	50 Hz +/- to 180 deg	0.06 deg	Using Clark Hess 6000

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Sl.	Quantity Measured / Instrument	Range/Frequency	*Calibration Measurement Capability (±)	Remarks
14.	Temperature Simulation [§] (Cal of process calibrators)			
	THERMOCOUPLE TYPES K,J,B,S,T,R,N,E,C,L,U	(-) 250 °C to 2300 °C	0.005 °C to 0.15 °C	Using DMM Fluke 8508A
	RTD-Pt 385, 100 Ω 10 Ω, 1k Ω	(-) 200 °C to 800 °C	0.001 °C to 0.033 °C	Using DMM Fluke 8508A
15.	Frequency [§]	10 mHz to 1 Hz 1 Hz to 100 kHz 100 kHz to 1GHz 1GHz to 26.5 GHz 26.5 GHz to 40 GHz	0.065 ppm 0.065 ppm to 0.008 ppm 0.008 ppm to 0.0002 ppm 0.00004 to 0.00007 ppm 0.00006 to 0.00007 ppm	Using Cs Beam (Agilent/ HP 5071A) Freq. Counter Fluke/PM6680B Measuring Receiver Agilent/N5530S Freq. Counter Agilent 53149A
16.	Rf Power [§]	1 MHz to 10 MHz 13 dBm to (-)30 dBm	4.1%	Using Measuring Receiver Agilent/N5532S With Power sensors Agilent/504 & 526
		10 MHz to 18 GHz 13 dBm to (-)90 dBm	5.5%	
17.	RF Attenuation [§]	10 MHz to 18 GHz 1 dB to 60 dB	0.15 dB to 0.40dB	Using Measuring Receiver Agilent/ N5532S Signal source E8257D

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Sl.	Quantity Measured / Instrument	Range/Frequency	*Calibration Measurement Capability (\pm)	Remarks
18.	Amplitude Modulation ^s CW : 1GHz, Rate 1kHz	Modulation Depth 10 % to 90 %	3.75 %	Using Measuring Receiver Agilent/N5530S
19.	Frequency ^s Modulation CW : 1GHz, Rate 1kHz	Frequency deviation 10 kHz to 200 kHz	3 %	Using Measuring Receiver Agilent /N5530S
20.	Total Harmonic ^s Distortion (Thd) 10kHz to 150kHz @ 50 Ω (sine wave source) Harmonics (n=4)	THD Range 0.01 % to 100 % of Fundamental	6.0 % to 11 %	Using Spectrum Analyzer Agilent/E4440A
21.	Reflection ^s Coefficient (P)	10 MHz to 18 GHz 0.020 to 0.33 (VSWR 1.05 to 2.0)	0.02 to 0.05 LU	Using Vector Network Analyzer R&S/ZVK with cal kit
22.	Time Interval ^s	100 ms to 10000 s	1 ppm	Using Function Generator Agilent 33220A, Counter PM 6680B

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23.	Dc Voltage*	1 mV to 100 mV 100 mV to 10 mV 10 V to 1000 V 1 kV to 10 kV	0.44% 0.01% 100 ppm to 50 ppm 50 ppm to 65 ppm 0.4%	Using DMM 34401A HV Probe 80F15
24.	AC Voltage*	50 Hz to 10 kHz 100 mV to 700 V 50 Hz 700 V to 10 kV 10 kV to 28 kV	0.12 % 0.12 % to 1.2 % 1.2 % to 2.5 %	Using DMM 34401A Using HV Probe P6015 & Fluke 80K40
25.	DC Current*	100 µA to 100 mA 100 mA to 1A	0.1 % to 0.08 % 0.08 % to 0.13 %	Using DMM 34401A
26.	AC Current*	50 Hz to 1 kHz 1 mA to 3 A 1 A to 20 A	0.13 % to 0.27 % 0.75 % to 0.25 %	Using DMM 34401A GDM 8246
27.	DC Resistance*	10 Ω to 1 kΩ 1 kΩ to 100 kΩ 100 kΩ to 100 MΩ	0.063% to 0.013 % 0.013 % 0.013 % to 0.8 %	Using DMM 34401A
28.	Thermocouple Types* K,J,B,S,T,R,N,E,C,L, U	(-) 250 °C to 2300 °C	0.04 °C to 0.55 °C	Using DMM Agilent 34401A
	RTD – Pt 385, 100 Ω 10 Ω, 1kΩ	(-) 200 °C to 800 °C	0.014 °C to 0.11 °C	Using DMM Agilent 34401A

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II.	SOURCE			
1.	DC Voltage ^s	1 µV to 100 µV 100 µV to 10 mV 10 mV to 10 V 10 V to 1000 V 1 kV to 8.7 kV	0.70 % to 80 ppm 80 ppm to 3.5 ppm 3.5 ppm to 1.5 ppm 1.5 ppm to 3 ppm 0.52 %	Using DC Ref. Std., Fluke 7004N, MFC 4808 MFC Fluke 5720A Null Detector AVM 2000 Ref. Divider, 80F15
2.	AC Voltage ^s	10 Hz to 1 kHz 1 mV to 1 V 1V to 100 V 40 Hz to 1 kHz 100 V to 1000 V 1 kHz to 100 kHz 1 mV to 10mV 10 mV to 1 V 1V to 100 V 100 V to 600 V 1 kHz to 20 kHz 100 V to 1000 V 100 kHz to 1 MHz 1 mV to 10 mV 10 mV to 20 V	 270 ppm to 25 ppm 25 ppm to 70 ppm 35 ppm to 120 ppm 300 ppm to 80 ppm 180 ppm to 25 ppm 25 ppm to 50 ppm 50 ppm to 140 ppm 35 ppm to 125 ppm 130 ppm to 0.11 % 40 ppm to 540 ppm	Using TVC Holt 11, Holt 12 MFC Datron 4808, Fluke 5720, Nanovoltmeter Keithley 182,

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3.	DC Current ^s	1 nA to 1 µA	0.2 % to 53 ppm	Using MFC Datron 4808
		1 µA to 100 µA	53 ppm to 10 ppm	Fluke 5720A, 5725A
		100 µA to 100 mA	10 ppm	Ballantine 1620
		100 mA to 1 A	10 ppm to 12 ppm	Keithley/263
		1 A to 20 A	12 ppm to 75 ppm	Std. Resistor
		20 A to 100 A	75 ppm to 520 ppm	Tinsley 5685,3111, DMM
		100 A to 1000 A	0.35 %	Fluke 8508A, Fluke 5500, 5220A Current Coil
4.	AC Current ^s	10 Hz to 1 kHz		Using AC Current shunt
		10 µA to 1 mA	300 ppm to 71 ppm	
		1 mA to 10 mA	71 ppm to 115 ppm	Using Holt HCS-1
		10Hz to 10kHz		MFC Datron 4808
		10mA to 1A	65 ppm to 120 ppm	Fluke 5520A, Ballantine 1620, 5220A, 5720A/5725A
		1A to 10A	120 ppm to 160 ppm	Standard resistor
		10Hz to 5kHz		Tin 5685A
		10A to 20A	160 ppm to 250 ppm	AC Measurement std. Fluke 5790
		50Hz		Nanovoltmeter Keithley 182
		20A to 1000A	0.3 % to 0.5 %	5500 Current Coil

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Sl.	Quantity Measured / Instrument	Range/Frequency	*Calibration Measurement Capability (±)	Remarks
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5.	DC Resistance ^b	10 μΩ	60 ppm	Using Tinsley 5685A/5685B 5686, Fluke 742A, Guideline 9330/9334/6520/65206 Guideline 6622A/6623A
		100 μΩ	35 ppm	
		1 mΩ	20 ppm	
		10 mΩ	20 ppm	
		10 mΩ to 1 Ω	20 ppm to 2 ppm	
		1 Ω to 1MΩ	2 ppm to 5 ppm	
		1 MΩ to 100 MΩ	5 ppm to 12 ppm	
		100 MΩ to 1 GΩ	12 ppm to 250 ppm	
		1 GΩ to 10 GΩ	250 ppm to 650 ppm	
6.	AC Resistance ^b	10 GΩ to 1 TΩ	0.065 % to 0.13 %	Using Std.Res. 5685/5686 A & B HP 16074A
		1 TΩ to 100 TΩ	0.13 % to 0.4 %	
		100 Hz to 1 kHz	470 ppm to 530 ppm	
		0.01Ω to 0.1Ω	65 ppm to 59 ppm	
		1 kHz		
		1 Ω, 10 Ω, 100 Ω, 1kΩ, 10 kΩ		
		10 kHz to 1 MHz		
		100 Ω, 1 kΩ	0.16 %	

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Sl.	Quantity Measured / Instrument	Range/Frequency	*Calibration Measurement Capability (±)	Remarks
7.	Capacitance ^s	1 kHz 1 pF to 100pF 100 pF to 1nF 1 nF to 1 µF 1kHz 1 µF to 10 µF 10 µF to 1 F 100 Hz 1 µF to 1 F 10 kHz to 1 MHz 10 pF, 100 pF, 1 nF	50 ppm to 5 ppm 5 ppm to 60 ppm 60 ppm to 150 ppm 150 ppm to 0.090 % 0.090 % to 0.13 % 0.073% to 0.12 % 0.21%	Using Fused Silica Capacitor A & H 1100 Std. Cap. GR 1409 4T Cap. Std. 1417 HP 16380
8.	Inductance ^s	1 kHz 10 µH to 100 µH 100 µH to 100 mH, 100 mH to 10 H	1.25 % to 0.053 % 0.053 % to 0.015 % 0.015 % to 0.032 %	Using Std. Self inductor HP 16483A, GR 1482, RLC digibrige 1693
9.	Power Factor/ Phase Angle ^s	50 Hz 0.2 PF-1 PF +/- 180 deg	0.025 deg	Using Power Energy Calibrator Rotek 8000
10.	Ac Power ^s (Active) 1 Phase Upf – 0.2 Pf	50 Hz 60 V to 240 V 100 mA to 50 A (1.2 W to 12 kW)	0.05 % to 0.18 %	Using Power Energy Calibrator Rotek 8000-3P

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Sl.	Quantity Measured / Instrument	Range/Frequency	*Calibration Measurement Capability (\pm)	Remarks
11.	Ac Power ^s (Active) 3 Phase Upf – 0.2pf	50 Hz 60 V to 240 V 100 mA to 50A (3.6 W to 36 kW)	0.1 % to 0.2 %	Using Power Energy Calibrator Rotek 8000-3P
12.	Dc Power ^s	100 mV to 1000 V 100 mA to 20 A (10 mW to 20 kW)	0.02 % to 0.032 %	Using Fluke 5520A
13.	Ac Energy ^s Active 1 Phase Upf – 0.2 Pf (Only With Watt-Hour Mode)	50 Hz 60 V to 240V 100 mA to 50A (1.2 W to 12 kW)	0.05 % to 0.2 %	Using P/E Calibrator Rotek 8000-3P
14.	AC Energy ^s Active 3 PH UPF – 0.2PF (Only with Watt-Hour Mode)	50 Hz 60 V to 240 V 100 mA to 50 A (3.6 W to 36 kW)	0.1 % to 0.2 %	Using P/E Calibrator Rotek 8000-3P

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Sl.	Quantity Measured / Instrument	Range/Frequency	*Calibration Measurement Capability (\pm)	Remarks
15 .	Oscilloscope ^s i.).Amplitude (Vertical axis Deflection Factor)	DC : 3 mV to 220 V (1 Mohm) DC : 3 mV to 5.5 V (50 ohm) 1kHz Square Wave 6 mV to 210 V (1 Mohm) 6 mV to 5.5 V (50 ohm)	0.1 % to 0.035 % 0.1 % to 0.035 % 0.07 % to 0.5 % 0.07 % to 0.5 %	Using Wavetek 9500
	Time base (Horizontal axis deflection factor)	450 ps to 55 sec	0.4 ppm	Using Wavetek 9500
	Bandwidth	Upto 100 MHz 100 MHz to 1 GHz 1 GHz to 8 GHz	2.50 % 2.5 % to 5 % 5 % to 8 %	Using Wavetek 9500
16.	Temperature Simulations ^s (Indicators/Recorders/ Controllers)			
	Thermocouple types K,J,E,T,N,R,S,B,C,L,U	(-) 250 °C to 2300 °C	0.03 °C to 0.15 °C	Using Multi function Calibrator Datron 4808

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	RTD – Pt 385, 100 ohm 10ohm, 1 kohm	(-) 200 °C to 800 °C	0.004 °C to 0.089 °C	Using Precision Resistor Fluke 742, Time Electronics 1067, DMM 1281
17.	Frequency ^s	10 MHz 10 mHz to 1 Hz 1 Hz to 100 kHz 100 kHz to 1 GHz 1 GHz to 26.5 GHz 26.5 GHz to 40 GHz	0.000017 ppm 0.065 ppm 0.065 ppm to 0.008 ppm 0.008 ppm to 0.0002 ppm 0.00004 ppm to 0.00007 ppm 0.00006 ppm to 0.00007 ppm	Using Cesium Beam HP/ 5071A Cs. Std HP 5071A, Function Generator Agilent 33220A, Signal Generator Agilent E8257D
18.	Rf Power ^s	1 MHz to 18 GHz Sensor Calibration Factors @ 1 mW 100 kHz to 10 MHz 13 dBm to (-)20 dBm -20 dBm to (-)30 dBm 10 MHz to 18 GHz 13 dBm to (-) 90 dBm	1.6% to 2.5% 2.2% to 4.1% 4.1% to 5% 4.2% to 5.5%	Using Bolometer Tegam/ F1130B Dual Power Meter LW1806 Using Signal Generator Agilent E8257D Standardised Using Using Measuring /receiver Agilent/ N5530S With sensors 504 & 526
19.	RF Attenuation ^p	10 MHz to 18 GHz 1 dB to 60 dB	0.15 dB to 0.35 dB	Using LW8300 step attenuator Signal source E8257D

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Sl.	Quantity Measured / Instrument	Range/Frequency	*Calibration Measurement Capability (±)	Remarks
20.	DC Voltage*	1 mV to 10 mV 10 mV to 1000 V	590 ppm to 70 ppm 70 ppm to 10 ppm	Using Multi Functional Calibrator Datron 4808
21.	AC Voltage*	50 Hz to 10 kHz		Using Multi Functional Calibrator Datron 4808
		1 mV to 10 mV	0.41% to 0.048 %	
		10 mV to 100 mV	0.048 % to 0.014 %	
		100 mV to 100 V	0.014 % to 0.005 %	
		100 v to 700 V	0.005 % to 0.02 %	
		10 kHz to 100 kHz		
		1 mV to 10 mV	0.41 % to 0.051 %	
		10 mV to 100 mV	0.051 % to 0.017 %	
		100 mV to 100 V	0.017 % to 0.011 %	
	10 kHz to 20 kHz			
	100 V to 700 V	0.011 % to 0.025 %		
22.	DC Current*	100 uA to 100 mA	300 ppm to 60 ppm	Using Multi Functional Calibrator Datron 4808, Fluke 5220A, Fluke coil 5500
		100 mA to 2 A	60 ppm to 138 ppm	
		2 A to 20 A	200 ppm to 950 ppm	
		20 A to 100 A	0.31%	
23.	AC Current*	50 Hz to 1 kHz		Using Multi Functional Calibrator Datron 4808, Trans conductance Amplifier Fluke 5220A, Fluke coil 5500
		10 mA to 100 mA	705 ppm to 128ppm	
		100 mA to 2 A	128 ppm to 254ppm	
		50 Hz		
	2 A to 20 A	254ppm to 0.29%		
	20 A to 1000 A	0.29% to 0.43%		
24.	DC Resistance*	1 mΩ to 100 mΩ	250 ppm	Using Multi Function Calibrator Dat4808,
		100 mΩ to 100 kΩ	250 ppm to 116 ppm	

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		100 k Ω to 100 M Ω 100 M Ω to 1 T Ω	116 ppm to 459 ppm 459 ppm to 0.6%	Standard Resistor Tin 5685, Vai 9409 OSAW, Welwyn, Alma
25.	AC Resistance*	1 kHz 1 Ω to 10 k Ω	120 ppm to 240 ppm	Using RL Standard HP16074 series
26.	Capacitance*	1 kHz 1 pF to 1 μ F 100 Hz 1 μ F to 1 F	0.05 % to 0.1 % 0.1 % to 0.58 %	Using Standard Capacitors HP 16380 GR 1417
27.	Inductance*	1 kHz 100 μ H to 10 H	0.055 % to 0.032 %	Using Standard Inductor Tinsley/4190
28.	Oscilloscope* 1. Amplitude (Vertical axis Deflection Factor)	DC : 3 mV to 200 V (1 Mohm) DC : 3 mV to 5.5 V (50 ohm) 1 kHz Square Wave 6 mV to 210 V (1 Mohm) 6 mV to 5.5 V (50 ohm)	0.1 % to 0.0353 % 0.1 % to 0.035 % 0.07 % to 0.5 % 0.07 % to 0.5 %	Using Wavetek 9500
	Time base (Horizontal axis deflection factor)	450 ps to 55 sec	0.4 ppm	

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	Bandwidth	Upto 100 MHz 100 MHz to 500 MHz	2.50 % 2.5 % to 5 %	
29.	Thermocouple Types* K,J,E,T,N,R,S,B,C,L,U	(-) 250 °C to 2300 °C	0.03 °C to 0.56 °C	Using Multi function calibrator Datron 4808
	RTD – Pt 385, 100 ohm 10 ohm, 1 kohm	(-) 200 °C to 800 °C	0.003 °C to 0.089 °C	Using Precision Resistor Fluke 742, Time Electronics 1067, DMM 1281
30.	Electrostatic Discharge (± 2 kV to ± 8 kV) a) Rise time b) Peak Current c) Current at 30ns d) Current at 60ns	a) 0.8 ns $\pm 25\%$ b) 7.5A to 112.20A $\pm 15\%$ c) 4A-60A $\pm 30\%$ d) 2A-30A $\pm 30\%$	a) $\pm 6.55\%$ b) $\pm 3.3\%$ c) $\pm 3.38\%$ d) $\pm 3.33\%$	Using Oscilloscope: R&S/ RTC 1044 Calibration Target (including 20dB attenuator with SMA(F) to BNC(M) connector) CTR2 As per IEC 61000-4-2:2008

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Sl.	Quantity Measured / Instrument	Range/Frequency	*Calibration Measurement Capability (±)	Remarks
31.	Electrical Fast Transients (50Ω & 1kΩ) at ±250V to ±4kV a) Rise Time b) Amplitude c) Pulse width d) Repetition frequency e) Burst Period f) Burst duration	a) 5ns±30% b) (250-4000V)±10% @50Ω (250-4000V)±20% @1kΩ c) 50ns ±20%(50Ω) & 50ns -15ns to +100ns(1kΩ) d) 5 kHz/100kHz)±20% e) 300 ms±20% f) 15 ms±20% @5kHz 0.75ms@100kHz	a) ±4.96% b) ±4.79% c) ±4.93% d) ±5.00% e) ±0.02% f) ±0.07%	Using Oscilloscope: R&S/ RTO 1044 -1kΩ Test Load: EM Test/KW 1000 50 Ω Test load: EM Test/ KW50 As per IEC 61000-4-4:2012
32.	Impulse Voltage ±(500V to 10kV) a) Amplitude: b) Rise Time c) Pulse Width	a) ±(500V to 10kV) ±10% b) 1.2µs ±30% c) 50 µs ±20%	a) ±5.04% b) ±5.45% c) ±5.04%	Using Oscilloscope R&S/ RTO 1044, HVProbe : Tektronix/P6015A
33.	Voltage Dips & Short Interruptions at 230V rms Voltage Time	a) 0%,40%,70%,80% of V b) 10ms to 5000mS	a) ±3.74% b) ±1.037%	Using Oscilloscope: R&S/RTO 1044, HVProbe: 1000:1 R&S/RT-ZH11 As per IEC 61000-4-11:2004

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Sl.	Quantity Measured / Instrument	Range/Frequency	*Calibration Measurement Capability (±)	Remarks
34	Slow damped Oscillatory wave Generator (250V to 2.5kV) (100kHz and 1MHz) a) Open Circuit voltage b) Voltage rise time c) Voltage Oscillation Frequency d) Repetition rate e) Burst duration f) Decaying g) Short circuit current h) Output impedance	a) 250V to 2500V ± 10% b) 75ns ± 20% c) 10µs for 100kHz± 10% 1µs for 1MHz± 10% d) 25ms for 100kHz± 10% 2.5ms for 1MHz± 10% e) 2s f) Pk5>50% of Pk1 and Pk10<50% of Pk1 g) Short Circuit current h) 200 ohm	a) circuit voltage± 4.1% b) Voltage Rise Time± 4.96% c) Voltage Oscillation Frequency± 5% d) Repetition rate± 1.5% e) Burst duration± 1.26% f) Decaying ± 4.1% g) Short circuit current ±3.35% h) Output impedance ±4.01%	Using Oscilloscope: R&S/RTO 1044 High Voltage Differential Probe PICO/TA044/1710390 Current Probe As per IEC 61000-4-11:2011

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Sl.	Quantity Measured / Instrument	Range/Frequency	*Calibration Measurement Capability (±)	Remarks
<u>MECHANICAL CALIBRATION</u>				
I.	ACCELERATION AND SPEED			
1.	Vibration Transducer/ Accelerometer [§] Parameter: Frequency, Acceleration, Sensitivity	Reference frequency 80/100/160 Hz 1g to 10gpk 10Hz-20Hz 20Hz-160Hz 160Hz-1200Hz 1200Hz-5000Hz	2.0% 2.59% 3.73% 4.11%	Using Spectra CS 18 PCB/301A10 by comparison method using Spectra CS 18 PCB/301A10 by comparison method
2.	Vibration Exciter [§] Parameter : Frequency And Acceleration.	1 to 10g 10Hz to 5kHz	2.50%	
3.	Vibration Meter [§] Acceleration Velocity Displacement	10Hz to 5kHz 1 to 10g pk 1 to 5mm/s pk up to 8mm p-p	2.3% 2.3% 2.3% 3.6%	Using Spectra CS 18 PCB/301A10 , PCB/353B04 PCB/301A08 by comparison method

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Sl.	Quantity Measured / Instrument	Range/Frequency	*Calibration Measurement Capability (±)	Remarks
4.	Vibration machine* Parameter.: Frequency, Acceleration, velocity, displacement	1g to 10gpk 10Hz to 2.0kHz	7%	Using Measuring amplifier, B&K 2525 , PCB/301A10 ,PCB/353B04 ,PCB/301A08 Reference accelerometer, storage oscilloscope By comparison method.
5.	Bump test machine* Parameter.: Acceleration, Pulse width duration	40gpk	3.0%	Using Measuring amplifier, B&K 2525 ,Columbia 5011 Reference accelerometer, , storage oscilloscope By comparison method.

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Sl.	Quantity Measured / Instrument	Range/Frequency	*Calibration Measurement Capability (\pm)	Remarks
<u>THERMAL CALIBRATION</u>				
I.	TEMPERATURE			
1.	Liquid-in-glass Thermometer	(-) 50 °C to 250 °C	0.09 °C	Using SSPRT Read out & Using Fluid bath, Magnifying glass, by Comparison method.
2	RTD/PRT (with & without Indicator), Temperature Controllers/Data loggers/Recorders with sensors	(-) 100 °C to 140 °C	0.064 °C	Using SSPRT Read out and Using Dry block calibrators, Field metrology well Zero point calibrator and PRT with 6.5 DMM by comparison method.
		0 °C	0.025 °C	
		140 °C to 660 °C	0.14 °C	Using SSPRT Read out and Using Dry block calibrators, Field metrology well Zero point calibrator and PRT with 6.5 DMM by comparison method.
		(-)100 °C to 140 °C	0.18 °C	Using SSPRT Read out and Using Dry block calibrators, Field metrology well and by comparison method.

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3	Thermocouple (with & without Indicator), Temperature Controllers/Data loggers/Recorders with sensors	140 °C to 660 °C	0.15 °C	Using SSPRT Read out and Using Dry block calibrators, Field metrology well and by comparison method.
4.	Dry block Calibrators	660 °C to 100 °C	1.60 °C	Using SSPRT with read out unit , by Comparison method
		(-)100 °C to 600 °C	0.15 °C	Using SSPRT with read out unit , standard S type TC with read out unit and by Comparison method
		660 °C to 1000 °C	1.6 °C	Using SSPRT with read out unit , standard S type TC with read out unit and by Comparison method

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Sl.	Quantity Measured / Instrument	Range/Frequency	*Calibration Measurement Capability (\pm)	Remarks
5.	RTD/PRT (with & without Indicator), Temperature Indicators/Data Logger/Recorder With sensors [#]	(-)100 °C to 140 °C	0.064 °C	Using SSPRT with readout unit and using Dry block Calibrators, Field Metrology well SSPRT with readout unit and PRT with 6.5 DMM, and by Comparison method
		140 °C to 660 °C	0.14 °C	Using Standard S Type TC with read out unit and using high temperature Dry block calibrators and Field metrology well, comparison method
6.	Temperature (with & without Indicator), Temperature Indicators/Data Logger/Recorder With sensors	(-)100 °C to 140 °C	0.18 °C	Using Standard S Type TC with read out unit and using high temperature Dry block calibrators and Field metrology well, comparison method
		140°C to 660 °C	0.15 °C	
		660 °C to 1000 °C	1.60 °C	
7.	Temperature indicator of Cold Chambers, ovens Incubators, Furnaces, Baths at single position.	(-)100 °C to 660 °C	0.18 °C	Using Standard S Type TC with read out unit, at single specified Position, by comparison method.
		660 °C to 1000 °C	1.60 °C	

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Sl.	Quantity Measured / Instrument	Range/Frequency	*Calibration Measurement Capability (\pm)	Remarks
8.	Freezer, Ovens, Incubators, Environmental Chambers by Multi Positioning of sensors	-70 °C to 100 °C 100 °C to 250 °C	1.06 °C 1.06 °C	Using Multiple RTDs with Data Logger, Multi position Spatial Temperature Mapping method By Comparison method

II. SPECIFIC HEAT AND HUMIDITY				
1.	Digital/Analogue Hygrometer, Rh/Temperature Sensor with Indicator/logger/ Controller [§]	15%Rh to 95% Rh At 10 °C to 70 °C to	0.88%Rh	Using Digital Rh Indicator with Probe Calibrated at different temperatures & Humidity points, Thunder RH Generator using Two Pressure method as source only with external temperature indicator by Comparison method
2.	Environmental Chamber/RH chambers/ Climtic Chamber	30% RH to 9% RH at 55 °C	2.0 % RH	Using Digital RH Indicator with probe and Calibrated RTD sensors with Data Logger by Multi position Spatial Humidity Mapping

* Measurement Capability is expressed as an uncertainty (\pm) at a confidence probability of 95%

[§]Only in Permanent Laboratory

*Only for Site Calibration

The laboratory is also capable for site calibration however, the uncertainty at site depends on the prevailing actual environmental conditions and master equipment used.

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